

Shell-and-Tube Heat Exchanger Engineering Training Course

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Overview

Shell-and-Tube Heat Exchanger Engineering Training Course is a one-week advanced course for mechanical, process, maintenance, and reliability teams who leave with a Shell-and-Tube Exchanger Performance and Integrity Decision Pack. The course connects thermal duty, TEMA configuration, hydraulic checks, mechanical arrangement, operating evidence, fouling, vibration, leakage, inspection, cleaning, repair, and return-to-service decisions. Agile Leaders Training Center delivers this course on shell-and-tube heat exchanger engineering.

Who Should Attend

- Teams responsible for heat-exchanger duty, process data, thermal review, and performance assurance
- Functions responsible for mechanical design review, materials, fabrication, inspection, and testing
- Teams responsible for operation, temperature approach, pressure drop, fouling, and energy performance
- Functions responsible for maintenance, cleaning, tube inspection, repair, and return to service
- Teams responsible for reliability, turnaround scope, evidence review, and intervention prioritization

The course assumes participants work with exchanger data sheets, operating trends, inspection records, or maintenance decisions and leaves out detailed vendor design calculations, code certification, welding qualification, and live intrusive work.

Departments and Industries

The course supports shell-and-tube heat exchanger decisions across process, manufacturing, utility, energy, and facilities operations.

- Process engineering, mechanical engineering, maintenance, reliability, and inspection
- Refining, petrochemicals, chemicals, fertilizers, and industrial gases
- Power, water, district cooling, utilities, and energy services
- Food processing, pharmaceuticals, metals, pulp, and manufacturing
- Facilities, data services, marine operations, terminals, and technical assurance

Learning Objectives

By the end of this course, participants will be able to:

- Analyze exchanger duty, data sheets, configuration, and design intent.
- Apply thermal and hydraulic performance checks.
- Evaluate mechanical arrangements, materials, access, and maintainability.
- Diagnose fouling, vibration, leakage, and performance loss.
- Prioritize inspection, cleaning, repair, and verification actions.
- Build an exchanger performance and integrity decision pack.

Course Agenda

Day 1: Establish Design Intent

- Process Duty, Heat Balance, Stream Data, Design Margin, and Data-Sheet Register
- TEMA Shell, Front-End, Rear-End, Pass, and Service Classification Map
- Fixed-Tubesheet, U-Tube, Floating-Head, Kettle, and Selection Decision Matrix
- ISO 16812 Mechanical Design, Materials, Inspection, Testing, and Documentation Map
- Temperature, Pressure, Corrosion Allowance, Fouling, and Design-Case Assumption Log

Day 2: Verify Thermal and Hydraulic Performance

- Sensible-Duty, Latent-Duty, Phase-Change, Heat-Balance, and Property Worksheet
- LMTD, Correction Factor, Temperature Approach, and Thermal-Cross Check Sheet
- Effectiveness-NTU, Heat-Capacity Rate, Duty, and Area Verification Model
- Overall Heat-Transfer Coefficient, Film Resistance, Wall Resistance, and Fouling Model
- Tube-Side Velocity, Shell-Side Flow, Pressure Drop, Bypass, and Leakage Review

Day 3: Review Mechanical Arrangement

- Shell, Channel, Head, Tubesheet, Tube Bundle, Nozzle, and Support Arrangement Drawing
- Tube Layout, Pitch, Pass Partition, Baffle Type, Spacing, Cut, and Window Review
- Thermal Expansion, Differential Movement, Expansion Joint, and Bundle-Removal Checklist
- Material Compatibility, Corrosion, Erosion, Velocity, Temperature, and Service Matrix
- Access, Vent, Drain, Isolation, Lifting, Cleaning, Plugging, and Maintainability Plan

Day 4: Diagnose and Maintain Performance

- Inlet-Outlet Temperature, Approach, Duty, Pressure Drop, Load, and Trend Dashboard
- Fouling, Scaling, Coking, Deposition, Corrosion, and Cleaning Decision Tree
- Flow-Induced Vibration, Baffle Damage, Tube Wear, Leakage, and Cross-Contamination Fault Tree
- Visual, Thickness, Eddy-Current, Leak, Hydrostatic, and Tube-Condition Inspection Plan
- Cleaning Method, Tube Plugging, Repair Scope, Acceptance, and Return-to-Service Log

Day 5: Practice Exchanger Decisions

- Exercise: Validate Duty, LMTD, Effectiveness-NTU, Area, and Fouling Assumptions
- Exercise: Diagnose Temperature, Pressure-Drop, Fouling, Bypass, and Leakage Evidence
- Exercise: Review TEMA Arrangement, Expansion, Access, Materials, and Maintainability
- Exercise: Prioritize Inspection, Cleaning, Plugging, Repair, and Verification Actions
- Capstone Exercise: Build the Shell-and-Tube Exchanger Performance and Integrity Decision Pack

Practical Exercises

The course uses suggested activities to connect exchanger design and operating evidence with maintenance and integrity decisions.

- Suggested activity: reconcile process data, heat balance, LMTD, effectiveness, area, coefficient, pressure drop, and design assumptions.
- Suggested activity: compare TEMA arrangements against thermal expansion, materials, access, bundle removal, cleaning, and service constraints.
- Suggested activity: diagnose a performance loss using temperature, flow, pressure drop, load, fouling, vibration, and leakage evidence.
- Suggested activity: build an inspection, cleaning, repair, acceptance, ownership, and return-to-service plan.

FAQs

Who should attend shell-and-tube heat exchanger engineering training?

Shell-and-tube heat exchanger engineering training suits experienced process, mechanical, operations, maintenance, reliability, inspection, and turnaround teams and assumes work with exchanger data or maintenance evidence.

How does shell-and-tube heat exchanger engineering differ from basic heat-transfer training?

Shell-and-tube heat exchanger engineering connects thermal calculations with configuration, hydraulics, mechanical arrangement, operating trends, inspection, fouling, repair, and lifecycle decisions, while basic heat-transfer training focuses on foundational heat-transfer concepts.

How is shell-and-tube heat exchanger performance assessed?

Shell-and-tube heat exchanger performance is assessed by comparing duty, temperature approach, LMTD, effectiveness, overall coefficient, flow, pressure drop, load, fouling resistance, baseline data, and operating trends.

How are shell-and-tube heat exchanger maintenance actions prioritized?

Shell-and-tube heat exchanger maintenance actions are prioritized from performance loss, fouling mechanism, leakage, vibration, inspection evidence, consequence, access, turnaround opportunity, repair acceptance, and required verification.

Conclusion

Participants take back a Shell-and-Tube Exchanger Performance and Integrity Decision Pack. The pack connects duty, configuration, thermal and hydraulic checks, mechanical arrangement, operating trends, fault diagnosis, inspection, cleaning, repair, ownership, and verification. It changes fragmented design and maintenance evidence into a traceable decision path for intervention and return to service.

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